WE CLAIM:

1. A method of removing a heavy metal from a composition, comprising:

(a) providing a fibrous protein fiber;

(b) agitating the fibrous protein fiber;

(c) making a slurry of the agitated fibrous protein fiber;

(d) contacting the agitated fibrous protein fiber slurry with a composition containing a heavy metal ion or a heavy metal ion complex; and

(e) filtering a supernatant produced in step (d) to remove the heavy metal from the composition bound to fibrous protein in the supernatant.

2. The method of claim 1 wherein the fibrous protein of the fibrous protein fiber is selected from the group consisting of keratins, collagens, fibrins, and elastins.

3. The method of claim 2 wherein the fibrous protein is a keratin and the keratin is selected from the group consisting of α-keratins and β-keratins.

4. The method of claim 3 wherein the keratin is a β-keratin.

5. The method of claim 4 wherein the β-keratin is obtained from avian feathers.

6. The method of claim 5 wherein the avian feathers are obtained from a species selected from the group consisting of a chicken, a turkey, a duck, and a goose.

7. The method of claim 6 wherein the feathers are chicken feathers.

8. The method of claim 3 wherein the keratin is a naturally-occurring keratin.

9. The method of claim 4 wherein the keratin is a naturally-occurring keratin.

10. The method of claim 3 wherein the keratin is selected from the group consisting of keratin proteins obtained from wool, eggshell membrane, silk, spider web, animal hair, human hair, animal nail, human nail, animal skin, and their components.

11. The method of claim 1 wherein the heavy metal composition includes at least one metal ion selected from the group consisting of strontium, cesium, cadmium, copper, uranium, radium, gold, silver, platinum, vanadium, manganese, cobalt, chromium, lead, mercury, nickel, and zinc.

12. The method of claim 3 wherein the heavy metal composition includes at least one metal ion selected from the group consisting of strontium, cesium, cadmium, copper, uranium, radium, gold, silver, platinum, vanadium, manganese, cobalt, chromium, lead, mercury, nickel, and zinc.

13. The method of claim 1 wherein the heavy metal composition includes at least one ion complex selected from the chloro complexes of gold, silver, and platinum and the cyano complexes of gold, silver, and platinum.

14. The method of claim 3 wherein the heavy metal composition includes at least one ion complex selected from the chloro complexes of gold, silver, and platinum and the cyano complexes of gold, silver, and platinum.

15. The method of claim 1 wherein the concentration of the fibrous protein in the fibrous protein fiber slurry is from about 0.1 to about 10 mg/mL.

16. The method of claim 15 wherein the concentration of the fibrous protein in the fibrous protein fiber slurry is from about 0.5 to about 5 mg/mL.

17. The method of claim 3 wherein the concentration of the keratin in the keratin protein fiber slurry is from about 0.1 to about 10 mg/mL.

18. The method of claim 17 wherein the concentration of the keratin in the keratin protein fiber slurry is from about 0.5 to about 5 mg/mL.

19. The method of claim 3 wherein the size of the fibers of the keratin protein fibers is from about 0.01 mm to about 2 mm.

20. The method of claim 19 wherein the size of the fibers of the keratin protein fibers is from about 0.05 mm to about 1 mm.

21. The method of claim 1 wherein the fibrous protein fiber slurry is agitated by a method selected from the group consisting of ultrasound and mechanical mixing.

22. The method of claim 21 wherein the fibrous protein fiber slurry is agitated by ultrasound.

23. The method of claim 21 wherein the fibrous protein fiber slurry is agitated by mechanical mixing.

24. The method of claim 3 wherein the keratin protein fiber slurry is agitated by a method selected from the group consisting of ultrasound and mechanical mixing.

25. The method of claim 24 wherein the fibrous protein fiber slurry is agitated by ultrasound.

26. The method of claim 24 wherein the fibrous protein fiber slurry is agitated by mechanical mixing.

27. The method of claim 1 wherein the method further comprises ultraviolet irradiation of the fibrous protein fibers.

28. The method of claim 3 wherein the method further comprises ultraviolet irradiation of the keratin protein fibers.

29. The method of claim 1 wherein the composition is alkaline.

30. The method of claim 29 wherein the pH of the composition is from about 9 to about 14.

31. The method of claim 30 wherein the pH of the composition is from about 12 to about 14.

32. The method of claim 3 wherein the composition is alkaline.

33. The method of claim 32 wherein the pH of the composition is from about 9 to about 14.

34. The method of claim 33 wherein the pH of the composition is from about 12 to about 14.

35. The method of claim 1 wherein the step of contacting occurs at a pressure of not greater than about 10 psi.

36. The method of claim 3 wherein the step of contacting occurs at a pressure of not greater than about 10 psi.

37. The method of claim 1 wherein the step of contacting occurs at a temperature of between about 20°C and about 90°C.

38. The method of claim 3 wherein the step of contacting occurs at a temperature of between about 20°C and about 90°C.

39. The method of claim 1 wherein the heavy metal is initially present in the composition at a concentration of at least about 5 ppb.

40. The method of claim 3 wherein the heavy metal is initially present in the composition at a concentration of at least about 5 ppb.

41. The method of claim 39 wherein the heavy metal is strontium, and the strontium is initially present in the composition at a concentration of at least about 92.8 ppb.

42. The method of claim 40 wherein the heavy metal is strontium, and the strontium is initially present in the composition at a concentration of at least about 92.8 ppb.

43. The method of claim 39 wherein the heavy metal is cesium, and the cesium is initially present in the composition at a concentration of at least about 100 ppb.

44. The method of claim 40 wherein the heavy metal is cesium, and the cesium is initially present in the composition at a concentration of at least about 100 ppb.

45. The method of claim 6 wherein the method further comprises the step of pretreating the keratin protein to open micropores in the keratin protein and to increase the ability of sulfur atoms in the keratin protein to bond to strontium or cesium.

46. The method of claim 45 wherein the keratin protein comprises essentially a fiber portion of the avian feather.

47. The method of claim 46 wherein the keratin protein is produced by separating the fiber portion from a quill portion of the avian feather.

48. The method of claim 1 further comprising the step of vitrifying the supernatant.

49. The method of claim 48 wherein the step of vitrifying the supernatant is performed with a vitrification agent selected from the group consisting of cements, glasses, and polymer based binders.

50. The method of claim 3 further comprising the step of vitrifying the supernatant.

51. The method of claim 51 wherein the step of vitrifying the supernatant is performed with a vitrification agent selected from the group consisting of cements, glasses, and polymer based binders.

52. The method of claim 1 wherein the heavy metal is lead, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 6.

53. The method of claim 1 wherein the heavy metal is copper, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 6.

54. The method of claim 1 wherein the heavy metal is cadmium, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 6.

55. The method of claim 1 wherein the heavy metal is mercury, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 2.

56. The method of claim 1 wherein the heavy metal is zinc, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 8.3.

57. The method of claim 1 wherein the heavy metal is chromium as Cr^{+6}, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 6.

58. The method of claim 1 wherein the heavy metal is nickel, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 6.2.

59. The method of claim 1 wherein the heavy metal is uranium, and the step of contacting the agitated fibrous protein fiber slurry with the composition occurs at a pH of about 6.

60. The method of claim 3 wherein the heavy metal is lead, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 6.

61. The method of claim 3 wherein the heavy metal is copper, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 6.

62. The method of claim 3 wherein the heavy metal is cadmium, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 6.

63. The method of claim 3 wherein the heavy metal is mercury, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 2.

64. The method of claim 3 wherein the heavy metal is zinc, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 8.3.

65. The method of claim 3 wherein the heavy metal is chromium as Cr^{+6}, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 6.

66. The method of claim 3 wherein the heavy metal is nickel, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 6.2.

67. The method of claim 3 wherein the heavy metal is uranium, and the step of contacting the agitated keratin protein fiber slurry with the composition occurs at a pH of about 6.

68. A method of removing a heavy metal from a composition, comprising:

(a) providing a keratin protein fiber;

(b) agitating the keratin protein fiber by a process selected from the group consisting of ultrasound and mechanical mixing;

(c) treating the keratin protein fiber with alkali at a pH of between about 9 to about 14;

(d) packing the agitated alkali treated keratin protein fiber into a column;

(e) passing the composition through the column under pressure to remove the heavy metal from the composition;

(f) desorbing adsorbed heavy metal from the column by treatment with an acid;

(g) washing the column for a first time;

(h) regenerating the column by passing alkali through the column; and

(i) washing the column for a second time.

69. The method of claim 68 wherein the keratin protein fiber is treated with alkali at a pH of from about 12 to about 14.

70. The method of claim 69 wherein the acid is HCl.

71. The method of claim 68 wherein the keratin is selected from the group consisting of α-keratins and β-keratins.

72. The method of claim 71 wherein the keratin is a β-keratin.

73. The method of claim 72 wherein the β-keratin is obtained from avian feathers.

74. The method of claim 73 wherein the avian feathers are obtained from a species selected from the group consisting of a chicken, a turkey, a duck, and a goose.

75. The method of claim 74 wherein the feathers are chicken feathers.

76. The method of claim 68 wherein the keratin is a naturally-occurring keratin.

77. The method of claim 68 wherein the keratin is selected from the group consisting of keratin proteins obtained from wool, eggshell membrane, silk,

spider web, animal hair, human hair, animal nail, human nail, animal skin, and their components.

78. The method of claim 68 wherein the heavy metal composition includes at least one metal ion selected from the group consisting of strontium, cesium, cadmium, copper, uranium, radium, gold, silver, platinum, vanadium, manganese, cobalt, chromium, lead, mercury, nickel, and zinc.

79. The method of claim 68 wherein the heavy metal composition includes at least one ion complex selected from the chloro complexes of gold, silver, and platinum and the cyano complexes of gold, silver, and platinum.

80. The method of claim 68 wherein the size of the fibers of the keratin protein fibers is from about 0.01 mm to about 2 mm.

81. The method of claim 80 wherein the size of the fibers of the keratin protein fibers is from about 0.05 mm to about 1 mm.

82. The method of claim 68 wherein the heavy metal is initially present in the composition at a concentration of at least about 5 ppb.

83. The method of claim 68 wherein the heavy metal is strontium, and the strontium is initially present in the composition at a concentration of at least about 92.8 ppb.

84. The method of claim 68 wherein the heavy metal is cesium, and the cesium is initially present in the composition at a concentration of at least about 100 ppb.

85. The method of claim 68 wherein the step of passing the composition through the column under pressure occurs at a temperature of between about 20°C and about 90°C.

86. The method of claim 68 wherein the step of passing the composition through the column under pressure occurs at a pressure of not greater than about 10 psi.

87. The method of claim 68 wherein the method further comprises the step of pretreating the keratin protein to open micropores in the keratin protein and to increase the ability of sulfur atoms in the keratin protein to bond to strontium or cesium.

88. The method of claim 68 wherein the keratin protein comprises essentially a fiber portion of the avian feather.

89. The method of claim 88 wherein the keratin protein is produced by separating the fiber portion from a quill portion of the avian feather.

90. The method of claim 68 wherein the heavy metal is lead, and the step of passing the composition through the column under pressure occurs at a pH of about 6.

91. The method of claim 90 wherein the composition has a lead concentration of less than about 20 ppb after being passed through the column.

92. The method of claim 68 wherein the heavy metal is copper, and the step of passing the composition through the column under pressure occurs at a pH of about 6.

93. The method of claim 68 wherein the heavy metal is cadmium, and the step of passing the composition through the column under pressure occurs at a pH of about 6.

94. The method of claim 68 wherein the heavy metal is mercury, and the step of passing the composition through the column under pressure occurs at a pH of about 2.

95. The method of claim 68 wherein the heavy metal is zinc, and the step of passing the composition through the column under pressure occurs at a pH of about 8.3.

96. The method of claim 68 wherein the heavy metal is chromium as Cr^{+6}, and the step of passing the composition through the column under pressure occurs at a pH of about 6.

96. The method of claim 68 wherein the heavy metal is nickel, and the step of passing the composition through the column under pressure occurs at a pH of about 6.2.

97. The method of claim 68 wherein the heavy metal is uranium, and the step of passing the composition through the column under pressure occurs at a pH of about 6.

98. The method of claim 97 wherein the composition has a uranium concentration of less than about 30 ppb after being passed through the column.